



# CLAREO HYDROGEN PERSPECTIVES



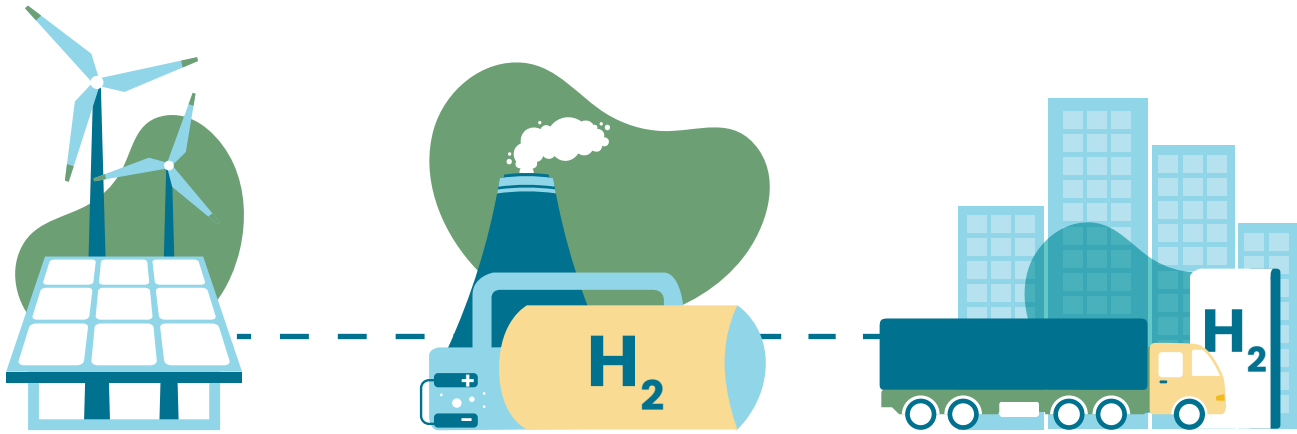
# GREEN HYDROGEN

## HYPE OR HOPE FOR THE ENERGY TRANSITION?

**Companies are hard at work testing green hydrogen technologies and new business models on their path to Net Zero.**

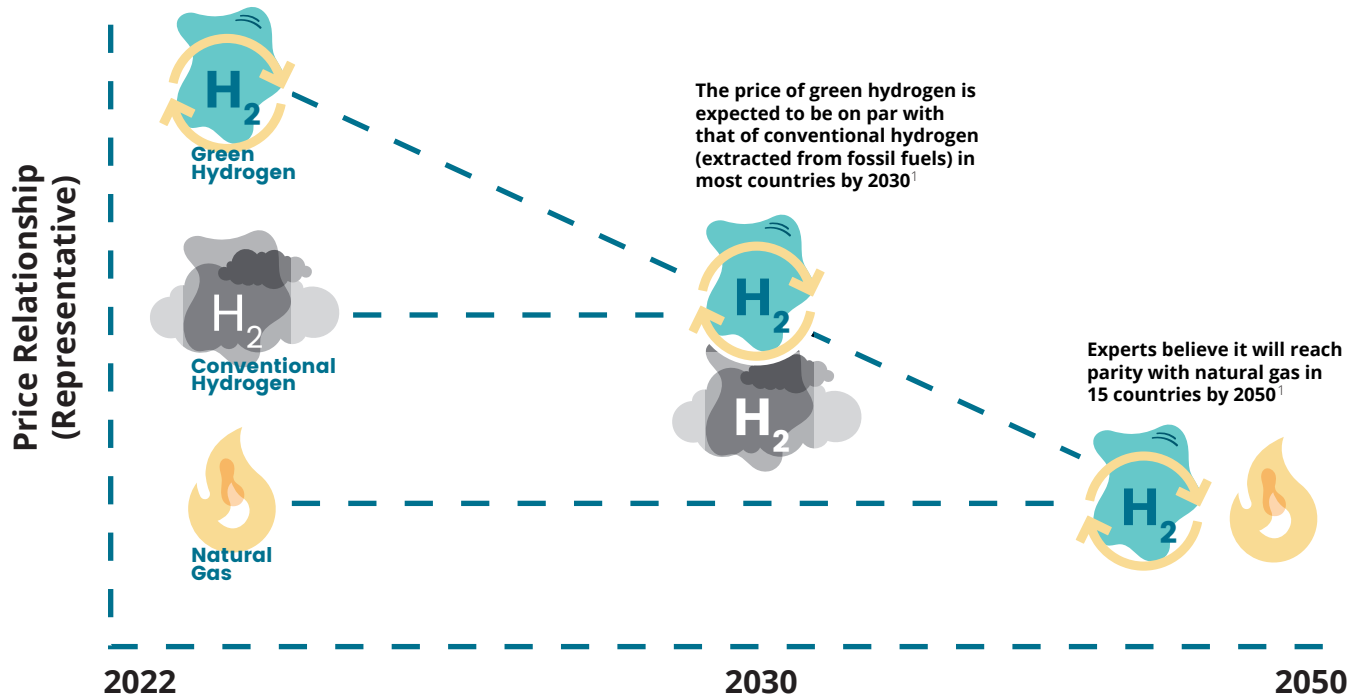
If you follow developments in the energy industry, it's impossible to avoid the ever-growing focus on green hydrogen. As more companies look to deliver on their Net Zero commitments, attention is turning to green hydrogen and its potential to solve some of the more intractable problems facing renewable energy and electrification, especially intermittency of supply.

As a carbon-free fuel, green hydrogen (using renewable energy to split water into hydrogen and oxygen through electrolysis) could address sectors of the economy that have proved harder to electrify, such as the steel and cement industries and the transportation sector with trucks, buses, trains and ships that depend on energy-dense fossil fuels. Hydrogen could also play an important role in decarbonizing power generation and for long-duration energy storage.



# FORECASTS:

Recent reports are giving us an updated view on how soon green hydrogen could play a meaningful role in the energy transition.



**560** =

low-carbon green hydrogen projects

**180**

GW of global electrolyzer capacity

Even without competitive pricing, the number of hydrogen projects already underway has grown rapidly to more than 560 low-carbon energy projects, representing 180 GW of global electrolyzer capacity - this is up from less than 200 MW in 2019.<sup>2</sup>



The long-term impact of Russian's invasion of Ukraine is yet to be determined, but higher natural gas prices and a shift towards European energy independence from Russia could accelerate investment in renewables and green hydrogen.

<sup>1</sup> BloombergNEF via UtilityDive

<sup>2</sup> Wood Mackenzie

# INSIDE VIEW:

To better understand this surge in activity for a technology that is not expected to scale for decades (absent additional government subsidies), we reached out to our network of leaders in the energy transition across electric and gas utilities, power producers, transportation companies, venture capitalists, developers and government policy leaders.

## WE PROBED ON SEVERAL KEY QUESTIONS: WHY INVEST IN GREEN HYDROGEN NOW?

WHICH INDUSTRIES AND USE CASES  
ARE LIKELY TO BE EARLY ADOPTERS?

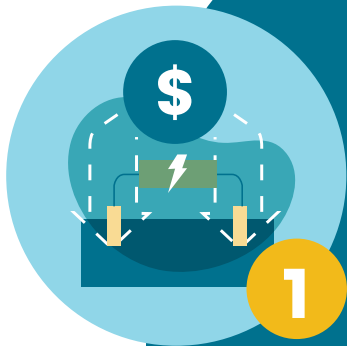
WHAT NEW BUSINESS MODELS ARE  
BEING TESTED?

What we heard was a diverse set of perspectives. A few companies had made significant progress and were already in the planning stages for large scale projects. Others were eager to engage in early stage projects and were championing its role in decarbonization. Still others expressed deep skepticism about hydrogen's ability to take a substantial role.



# HYDROGEN INSIGHTS:

**DESPITE THE DIVERGENCE IN PERSPECTIVES, SEVERAL THEMES DEVELOPED FROM THESE DISCUSSIONS:**



Demonstration projects will be important to de-risk the technology for hydrogen production, storage and transportation and to conduct low-cost experimentation around new business models



Viability will depend on availability of low-cost clean energy (such as wind, solar, nuclear and hydro power) to make project economics positive



Greater scale will be needed to drive down cost of production, namely electrolyzers, to be competitive with conventional hydrogen and natural gas

# INVESTMENT DRIVERS:

**So if green hydrogen is not expected to be competitive for some time, why all the activity now?**

## **ACTION ON CARBON-NEUTRAL COMMITMENTS**

Many companies have made commitments to Net Zero carbon emissions and see green hydrogen as playing an important role in delivering on those commitments, and for their customers seeking clean energy. Hydrogen factors heavily into their decarbonization plans, and companies realize getting to scale will take time.

## **ACCESS TO GOVERNMENT FUNDING**

The U.S. Department of Energy will be funding \$8.5B in clean hydrogen projects through the recently-passed Infrastructure and Jobs Act. Several companies we spoke with were seeking or had obtained government funding for demonstration projects.

## **NEW BUSINESS MODELS**

While much of the focus will be on de-risking hydrogen technology and driving down cost, it will be equally important to identify new business models for hydrogen. Given the high cost of transporting hydrogen, new business models will likely include co-location of low-cost zero carbon energy with hydrogen production, distribution and/or hydrogen off-takers. Strategies and partnerships are being formed now to define and optimize how these so-called hydrogen hubs may operate, as they will be highly dependent on location-specific factors.



# PLANNING AND EXPERIMENTS IN ACTION:

## AFTER A LOT OF TALK IN THE U.S. ABOUT HYDROGEN OVER THE LAST COUPLE OF YEARS, COMPANIES ARE TAKING ACTION.

Several large companies are in the planning or demonstration phases of hydrogen projects and have highlighted them in investor presentations and sustainability reports.



Global energy company AES signed a MOU in 2021 with an established international hydrogen producer to conduct a feasibility study for the first large green hydrogen-based ammonia project in Chile. The company wants to be the first in the world to create green ammonia as a maritime fuel for large ships. Electrolyzers powered by low-cost renewable energy in Chile will extract hydrogen from water and then combine with nitrogen to make ammonia, rather than using fossil fuels.



Another example of this focus on new business models is Constellation Energy's demonstration project at their Nine Mile Nuclear plant north of Syracuse, New York. Nuclear plants, including Constellation's, have recently struggled to compete with low cost natural gas and renewables in the energy markets. With on-site water supplies and carbon-free electricity production available 24/7, nuclear plants could be good candidates for siting hydrogen production, which could provide new business models to improve the economics of nuclear power. Supported by a U.S. Department of Energy grant, Constellation's pilot project will include hydrogen production, storage and use enabled by a 1-MW electrolyzer. The goal is to produce hydrogen before the end of 2022.



Dominion Energy completed the first phase of its hydrogen blending pilot project in Utah in June 2021, where it blended 5% hydrogen in a test gas distribution system. The goal was to learn about the impact of hydrogen on gas lines and appliances. The company is now seeking approval to continue with phase 2 of the project, expanding to a portion of the broader system in Utah and in other states, with the goal of eventually increasing the percentage of hydrogen in the system.

**Driven by decarbonization commitments and opportunities for new business models, these companies and many others are now busy laying the foundation for hydrogen's role in the energy transition. Learnings from these and other early hydrogen projects will be important inputs into the development of successful business models and partnerships, providing first-mover advantages for participants. They will, in part, help determine the scale and pace at which green hydrogen will grow.**

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